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Efficacy of twelve sessions of 905nm infrared laser on acne vulgaris

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Abstract
Aim: To assess the efficacy of 12 sessions with 905 nm the infra-red laser in patients with acne vulgaris. Materials and Methods: Study design was a randomized controlled study as forty patients with facial acne were randomly assigned into 2 equal groups; study and control groups. Study Group (A): includes 20 patients received infrared laser with 905nm wavelength and intensity of 6J/cm², while control Group (B): includes 20 patients received shame treatment. Before and after treatment, all patients were assessed by comparative acne severity scale. In addition, facial photographs were taken using a digital camera. Photographs were taken using the same manner at all measurement times. Results: There was a highly significant difference between pre and post-treatment phases within laser group (A) as the p-value = (0.0001), also there was a highly significant difference between both groups at post-treatment phase as the p-value = (0.0001).Conclusion: Twelve sessions with 905 nm infrared laser provide a satisfying improving effect on acne vulgaris patient.

Keywords
Laser; Acne vulgaris; Face

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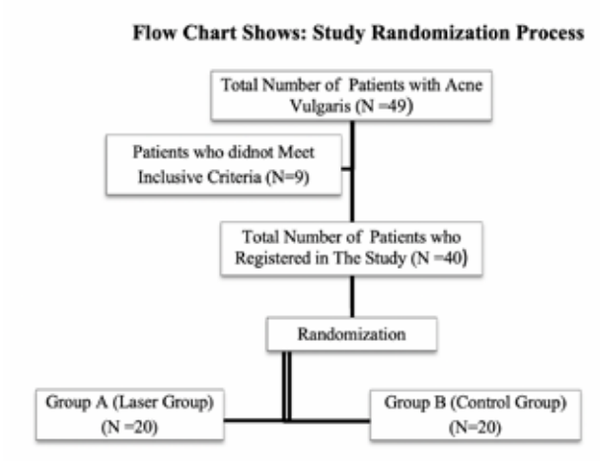
Introduction

Acne vulgaris is a skin condition that is prevalent in adolescents and can spread to adulthood [1]. Although the disorder is not dangerous, it has an effect on the social and emotional aspect of the patient's life [2]. It may lead to psychological problems such as loss of self-esteem and, in some cases, depression or suicide [3]. Acne is generally characterized by a red squamous skin called seborrhea, blackheads, papules, pustules, papules and large areas with skin scars [4].

The process of acne formation involves four major events; obstruction of the pilosebaceous canal, secretion of sebum, colonization of Propionibacterium acne and inflammation. Propionibacterium acne acts on triglycerides that cause inflammatory reactions by releasing their cytokines [5]. Current treatments for acne vulgaris include topical and oral treatments, such as topical antibiotics, topical retinoids, salicylic acid, and alpha-hydroxy acids. In severe cases, systemic antibiotics such as tetracycline, oral retinoids, and certain hormones may be used [6]. Despite many treatment options, most patients with acne vulgaris may poorly respond to treatment or may have drug adverse effects [7]. Many years ago, patients with acne vulgaris used sunlight to improve their condition. In clinical practice, although some patients have continued to use optimized topical and systemic treatment, as well as skin care, they nevertheless show a partial persistence of the acne lesion because it resists pharmacological treatment, which is embarrassing. These challenges intensify the need to research and explore other non-pharmacological treatments for acne vulgaris [8].

Phototherapy has been introduced as an alternative therapy for treating acne vulgaris with minimal side effects [7]. Phototoxic agents resulting from the absorption of laser light by Propionibacterium acnes cause their destruction. In addition, the photothermal mechanism for certain laser light; infrared light, for example, can destroy the sebaceous glands and reduce acne lesions [9]. While red light can exert its effect on acne lesions and reduces inflammation by increasing macrophages and other cells, which releases many cytokines [10].The spectral range of low-intensity laser treatment ranges from red to near-infrared (630-1000 nm) with non-thermal power has been safely applied in different clinical groups [11].

Figure 1. Study randomization process



Therefore, there was no standard protocol for LLLT since several previous studies applied different laser types with different spectral ranges and different treatment times for the treatment of acne and achieved different results. The purpose of our study, therefore, was to evaluate the efficacy of the 905 nm wavelength infrared laser applied to patients suffering from acne vulgaris for 12 sessions (3 months).

Preferred assessment methods for acne severity can be described as practical and time-efficient methods that typically depend on the qualitative grading of severity rather than acne counting [1]. The comprehensive acne severity scale (CASS) is characterized by its validity and globally used in measuring the severity of acne at relevant sites of disease involvement. In clinical practice, CASS has the following advantages; flexible (evaluation of each region independently), comprehensive (classification of the different areas of the lesion, facilitation of the validity of the content) and practicality (efficient time) [12].

Consequently, to facilitate the results of research, CASS is important for assessing the severity of acne in practice and in the future. Previous studies suggest that training in the IGA system, based on CASS, can increase inter and intra-evaluator reliability [13].

Material and Methods

Subject

Forty-nine patients (men and women) with facial acne were selected from the Egyptian Railway Hospital (Department of Dermatology). Forty patients participated in this study who met the following inclusive criteria of the study; Patients were both; men and women, ranging in age from 18 to 40 years with mild to a moderate inflammatory lesion of facial acne vulgaris that has been going on for at least 3 months before examining the lesions. Women who used hormonal contraceptives had been in a stable dose for at least 3 months prior to the screening test. The subject was willing and able to meet all the requirements of the study protocol. While, nine patients who had one or more of the following criteria were excluded from the study; smokers, patients had used oral retinoids in the last year or any other treatment for acne in the last 3 months, patients with photosensitivity, pregnant patients, severe acne in need of systemic therapy, patients with infected acne, and fungi or virus and patients with skin lesions that can interfere with the evaluation of acne vulgaris.

Design of the study:

It was a randomized controlled study as it is shown in Figure 1 (Flow chart shows the study randomization process).

Procedures:

All aspects of protocol treatment were approved by an ethics committee of the Faculty of Physical Therapy, Cairo University, Egypt.

Initial Skin Assessment:

Each patient was written consent form, and then they were assessed by comparative acne severity scale. In addition, facial photographs were taken using a digital camera (PANASONIC, Tokyo, Japan). Photographs were taken using the same manner at all times.

Treatment procedure:

After initial skin assessment, patients' skin was cleansed with alcohol to remove skin debris and reduce skin resistance, and then patients were assigned randomly into two groups:

Group (A): Twenty patients received scanning mode of the pulsed infrared laser (CEI 76-2/1999-1.Made in Italy) emitting wavelength of 905 nm with peak power 25w and impulse duration 100 Ns at an intensity of 6J/cm2.

Group (B): Twenty patients received shame treatment.

Treatment was done in the Physical therapy Department of Railway Hospital and it was continued for 4 weeks and at a rate of 3 sessions per week (12 sessions).

Follow up Skin Assessment:

After four weeks of treatment, the patients re-assessed by comparative acne severity scale and digital camera as in initial assessment.

Data collection:

Patient demographic data, as well as data gained from skin assessment (initial and follow up) using comparative acne severity scale, were collected. The statistical analysis was performed using SPSS, version 17 (SPSS Inc., Chicago, IL, USA). Descriptive analysis of demographic data (mean, and the standard deviation) in both groups and t-test analysis to compare means as parametric data between both groups were done. Also changing in data gained from comparative acne severity scale assessment before and after treatment within each group as non-parametric data was tested using Wilcoxon signed–ranks while the comparison of means between both groups was tested using Mann-Whitney, value of $p < 0.05$ was considered statistically significant.

Results

Baseline and patients demographic data:

All forty patients (12 women and 28 men) conducted and completed the study and none of them were excluded for failure to complete treatment. Six Females and 14 Males with the total number of 20 patients were randomly selected as Group A. (Laser group), their ages mean value was (23.95±4.78). All patients in this group tolerated the laser protocol and no adverse effect or reaction was detected. Also, 14 Males and six females with the total number of 20 patients were randomly selected as group B. (control group), and their ages mean value was (23.85± 5.274). The mean rank values of pre-treatment measurements of Comprehensive Acne Severity Scale (CASS) was (19.45) in Group A (infrared laser group) and it was (21.55) in Group B (control group) as it is shown in Table (1). There were no significant differences between the two group regarding all Baseline values (Age, Sex, pre-treatment acne scores values) as p-value > (0.05) for all as it is shown in Table (1).

Table 1. Data baseline for patients in laser and control group

Data baseline	Laser Group (A)	Control Group B	P value
Age	(23.95±4.78).	(23.85± 5.274).	p > (0.05)
Male No.	14	14	NS.
Female No.	6	6	NS.
Mean rank values of acne scale scores	(19.45)	(21.55)	p > (0.05)

Table 2. Comparison of differences mean rank; pre and post-treatment phase within each group and between groups

Group	Pre- Post-treatment mean rank of difference			P value
	(-) Rank	(+) Rank	Ties	
Group (B)	4.2	3.5	----	0.206
N:20 patients	N:5 patients	N:2 patients	N:13 patients	N.S
Group (A)	10	0.0	----	0.0001
N:20 patients	N:19 patients	N:1 patient	N:0 patients	H.S

N: Number N.S: Non-Significance H.S: Highly Significance

Table 3. Comparison of mean rank between both groups; pre and post-treatment phase

Treatment phase	Acne scale mean rank scores		
	Group (A)	Group (B)	P value
Pre-treatment	19.45	21.55	0.54 (N.S.)
Post-treatment	11.40	29.60	0.0001 (H.S)

N.S: Non-significance H.S:Highly significance

Table (2) and Figure (2) that; the difference mean rank value of acne severity scale scores between pre-treatment and post-treatment in control group (B) was (4.2) for negative of differences mean rank and it was (3.5) for positive of differences mean rank and there was no significant difference within control group (B) as p-value p (0.206). while in laser group (A); the difference means the rank value of acne severity scale scores between pre-treatment and post-treatment was

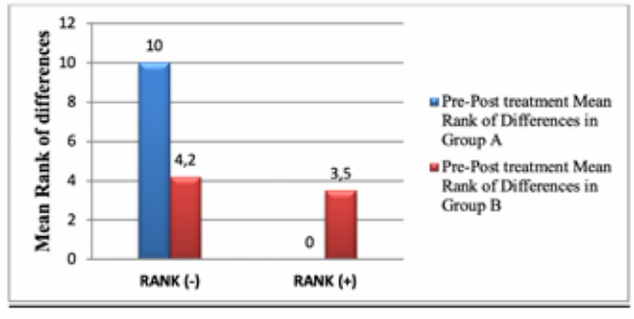


Figure 2. Comparison of differences mean rank within each group and between groups; pre and post-treatment phase.

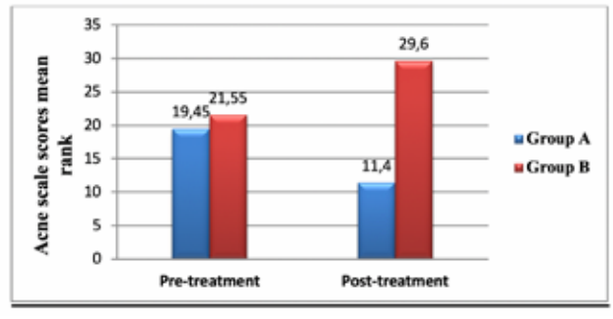


Figure 3. Comparison of mean rank between both groups; pre and post-treatment phase.

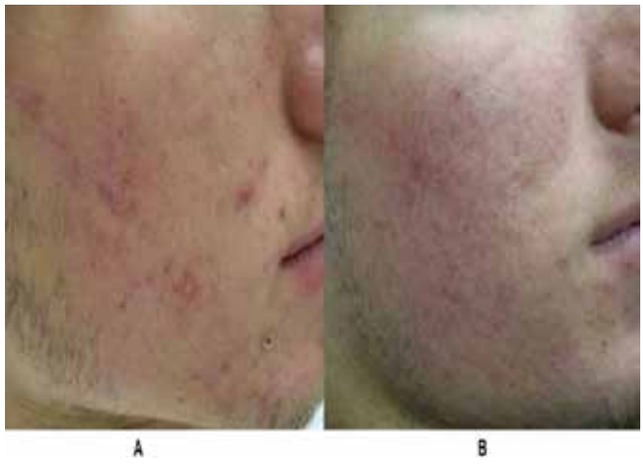


Figure 4. Male patient in laser group; A) Before treatment, B) After treatment.

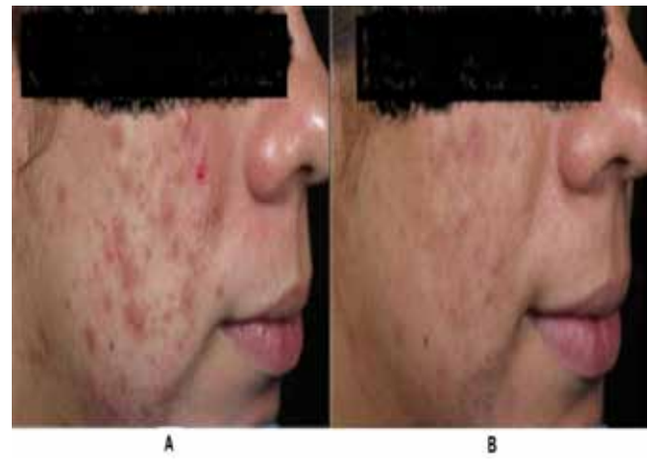


Figure 5. Female patient in laser group; A) Before treatment, B) After treatment.

(10) for negative differences mean rank and it was (0) for positive differences mean rank and there was a highly significant difference within the laser group (A) as the p-value = (0.0001). Moreover, in Table (3) and in figure (3) show that the mean rank value of acne severity scale scores pre-treatment in control group (B) was (21.55) while it was (19.45) for laser group (A) and there was no significant difference between both group at that treatment phase as p-value (0.54) and this mentioned before. Also, Table (3) and figure (3) show that the mean rank value of acne severity scale scores in the post-treatment control group (A) was (29.60) while it was (11.4) for laser group (A) and there was a highly significant difference between both groups at that treatment phase as the p-value = (0.0001). Figure 4&5 show examples of two selected cases (male and female) treated with the infrared laser as the images taken by camera compare between pre and post-treatment for each case.

Conclusion: Twelve sessions with 905 nm infrared laser provide a satisfying improving effect on acne vulgaris patient.

Discussion

A controlled randomized study was conducted to determine the effect of twelve sessions with the infra-red lesions in forty (male and female) patients suffering from acne vulgaris. The results which were obtained in the study indicated that twelve sessions with infrared laser provide a satisfying effect on acne vulgaris patient and they confirm the observations of following previous studies:-

The therapeutic effect of the low laser could be related to the destruction of bacteria and reduction of seborrheic glands formation. Post-inflammatory hyperpigmented spots are also reduced by the low-power therapeutic laser. The laser may be applied also to improve collagen formation, enhance protein production and reduce scarring, as it facilitates the healing process, cellular metabolism and mitochondrial activity [14].

The philosophy of acne treatment by laser is based on two mechanisms; lasers emitting wavelengths in the visible light spectrum (400-700 nm) where the light absorption peak range by porphyrins stored in P. acnes is located (500-700 nm) and subsequent self-destruction of the bacteria [15], in addition, long-wave lasers, near and far infrared, damage the sebaceous glands by deeper photothermal penetration [16].

One of the phototherapy mechanisms acting on acne vulgaris may be achieved through light absorption by p.acne produced-porphyrins which are considered as a part of its normal metabolism and act as photosensitizers. Light absorption by porphyrins leads to a photochemical reaction which forming reactive free radicals and oxygen species and finally leads to the destruction of bacteria. Many previous studies elicited that LLLT in the red to the near-infrared with a range of the spectrum (630–1000 nm) and power not more than 200mW with no thermal effect is effective for acne vulgaris treatment when used alone or in combination [17].

One of these studies demonstrated that twelve sessions of treatment using 630-nm red spectrum LLLT with an intensity of 12 J/cm2/ twice a week in conjunction with 2% topical clindamycin showed a significant reduction in active acne lesions; while the same study showed no significant effects when using 890 nm laser [18].

A few studies also showed that the combination of blue and red lights have synergistic effects in acne treatment due to the anti-bacterial and anti-inflammatory effects of blue and red lights respectively [17].

Na and Suh, (2007) evaluated the red light laser efficacy on mild to moderate severity of acne, as laser application was applied for 15minutes, twice / a day, and for 8 weeks. Photographs, total counts of acne, and a visual analog scale were assessed; clearance in total lesion count was 55% at 8th Week [19]. The results of the previous study are too close to our study results but the duration of the previous study (twice a day for 8 weeks) was too longer than our study (three days per week for 4 weeks).

Gold et al., (2005) compared the infra-red laser with wavelength 904nm to solution therapy seeking for safety and efficacy in patients with mild-to-moderate severity of acne vulgaris. They found that the infrared laser may be safer and more efficient in the treatment of inflammatory acne [20].

Morton et al., (2005) assessed the effect of Infra-red with wavelength 908nm therapy in 30 patients with mild-to-moderate severity of acne. Patients received twenty minutes of laser treatments for five weeks. The authors reported significant improvement of acne at the fourth-week post-treatment. The results of the previous study are close to our study results but

with different wavelength [21].

Charakida et al., (2004) investigated the role of various wavelengths and methods of laser applications used for acne treatment and they concluded that the combination of blue and infrared lasers application appears to be better than the application of blue laser alone, with minimal adverse effects [22]. In a randomized, controlled study; a combination of the infrared and blue laser (904nm and 415nm, respectively) were compared to the blue laser (415nm) and white light phototherapy or 5% benzoyl peroxide on 107 patients with mild-to-moderate severity of acne. The results of this study elicited that blue- infrared laser radiation combination was significantly more efficient to blue laser or benzoyl peroxide in the treatment of acne vulgaris, so it concluded that blue laser and infra-red laser may have synergistic acting in improving inflamed acne through combining of killing bacteria and minimizing inflammation [23]. Sigurdsson et al., (1997) compared different visible light lasers to elicit the most effective wavelengths as 30 patients with mild to moderate severity acne vulgaris in various body location; face, and/or back and/or neck were treated with three various sources of light. Patients were treated 3sessions per week and for 7 weeks, and 20 min per session. They concluded that; all the light sources using 'full spectrum', green and violet laser light improved the acne, there were no significant differences between the three different light sources and all visible lights are effective alternative treatments for acne vulgaris [24].

Conclusion

Twelve sessions with 905 nm infrared laser provide a satisfying improving effect on acne vulgaris.

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Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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